



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

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CENTRE
NUMBER

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CHEMISTRY

0620/22

Paper 2

October/November 2013

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may need to use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 16.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **15** printed pages and **1** blank page.



- 1 (a) Choose from the list of compounds below to answer the following questions.

ammonia
ammonium chloride
calcium carbonate
calcium oxide
copper(II) sulfate
ethane
iron(II) chloride
methane
water

Each compound can be used once, more than once or not at all.

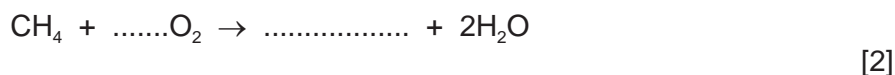
Which compound:

- (i) is an alkaline gas, [1]
- (ii) is a gas contributing to climate change, [1]
- (iii) is a salt containing only non-metals, [1]
- (iv) turns blue cobalt chloride paper pink, [1]
- (v) reacts with an acid to release carbon dioxide, [1]
- (vi) gives a light blue precipitate when aqueous sodium hydroxide is added to a solution of its aqueous ions? [1]

- (b) What is the meaning of the term *compound*?

.....
..... [1]

- (c) Complete the following symbol equation for the complete combustion of methane in oxygen.



[Total: 9]

- 2 (a) The table describes the reactivity of some metals with hydrochloric acid.

metal	observations
calcium	Many bubbles produced. Reaction mixture may boil.
magnesium	Steady stream of bubbles produced. Reaction mixture gets hot.
sodium	Many bubbles produced. May explode.
zinc	Slow stream of bubbles produced. Reaction mixture rises slightly in temperature.

Put these metals in order of their reactivity.

least reactive \longrightarrow most reactive

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[2]

- (b) Complete the word equation for the reaction of magnesium with hydrochloric acid.

magnesium + hydrochloric acid \rightarrow +

.....

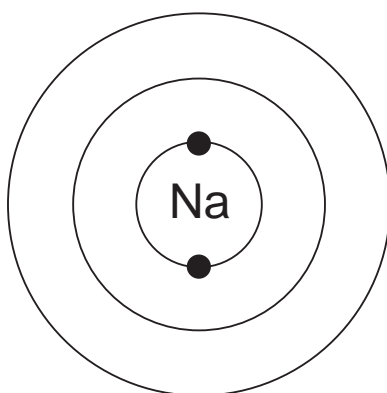
[2]

- (c) When magnesium reacts with hydrochloric acid, magnesium atoms lose electrons. What type of magnesium particle is formed?
Put a ring around the correct answer.

covalent **ion** **molecule** **proton**

[1]

- (d) Complete the diagram to show the electronic structure of a sodium atom.



[2]

(e) A student added large lumps of zinc to 20 cm³ of 2 mol/dm³ hydrochloric acid. She carried out the reaction at 15 °C. She measured the volume of gas given off at various time intervals.

(i) Draw a labelled diagram of the apparatus she could use for this experiment.

[3]

(ii) Describe **three** different things she could do to increase the rate of this reaction.

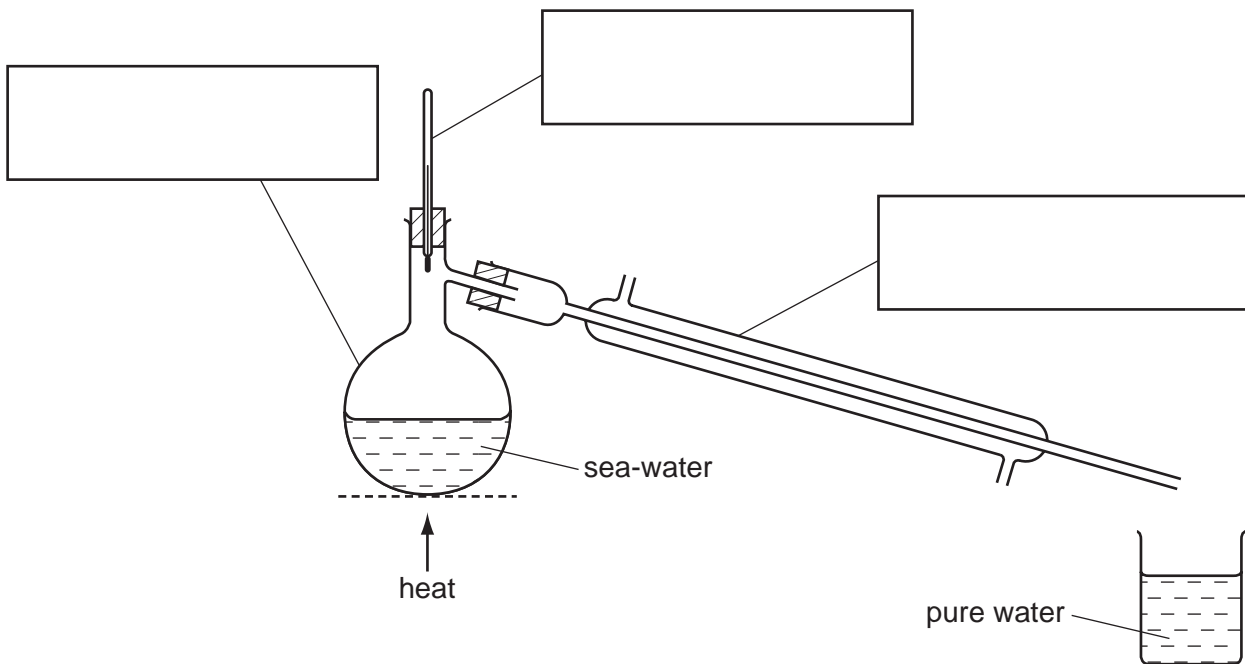
1.

2.

3. [3]

[Total: 13]

- 3 The diagram below shows the apparatus which can be used to obtain pure water from sea-water.



- (a) State the name of this process.

..... [1]

- (b) Label the boxes on the diagram above with the correct names of the pieces of apparatus shown. [3]

- (c) Complete the following sentences using words from the list below.

boils **condenses** **cools** **freezes**
higher **lower** **melts**

Water has a boiling point than salt. When a solution of salt is heated strongly, the water and escapes as steam. When the steam cools, it back to liquid water. [3]

(d) The table shows the concentration of the seven most abundant compounds in sea-water.

compound	ions present	concentration in g/m ³
calcium carbonate	Ca ²⁺ and CO ₃ ²⁻	100
calcium sulfate	Ca ²⁺ and SO ₄ ²⁻	1 800
magnesium chloride	Mg ²⁺ and Cl ⁻	6 800
magnesium sulfate		5 700
potassium bromide	K ⁺ and Br ⁻	100
potassium chloride	K ⁺ and Cl ⁻	800
sodium chloride	Na ⁺ and Cl ⁻	28 000

(i) Which negative ion is present in the greatest concentration in sea-water?

..... [1]

(ii) Which positive ion is present in the lowest concentration in sea-water?

..... [1]

(iii) Write the formulae of the **two** ions present in magnesium sulfate.

..... [2]

[Total: 11]

- 4 (a) Match the compounds on the left with the statements on the right.
The first one has been done for you.

butane	—	a hydrocarbon containing four carbon atoms
poly(ethene)		it decolourises bromine water
ethene		it is the main constituent of natural gas
methane		it contains a –COOH functional group
ethanoic acid		it has a very long chain of carbon atoms

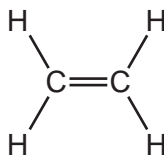
[4]

- (b) Methane and ethene are hydrocarbons.

- (i) What is meant by the term *hydrocarbon*?

..... [1]

- (ii) The structure of ethene is shown below.



Use this structure to explain why ethene is an unsaturated hydrocarbon.

..... [1]

- (c) Molecules of ethene react together at high temperature and pressure to form poly(ethene).

Which **one** of the following words best describes the molecules of ethene in this reaction?
Put a ring around the correct answer.

acids **alkanes** **monomers** **polymers**

[1]

(d) Ethanoic acid can be made by the oxidation of ethanol.

(i) What is meant by the term *oxidation*?

..... [1]

(ii) Ethanol can be made by fermentation.
Complete the word equation for fermentation.

..... $\xrightarrow{\text{yeast}}$ + ethanol
.....

[2]

[Total: 10]

5 (a) Explain why metals are often used in the form of alloys.
In your answer, write about

- the structure of an alloy,
- why alloys are often more useful than pure metals.

.....

.....

.....

.....

..... [3]

(b) Iron is a transition element.

(i) Which two of the following statements about iron are correct?

Tick **two** boxes.

A freshly-cut surface of iron is green in colour.

Iron exists in only one oxidation state in its compounds.

Iron has a high density.

Iron has a giant covalent structure.

Iron has a high melting point.

[2]

(ii) Describe **one** method of rust prevention and explain how it works.

method

how this works

..... [2]

(c) Iron is used as a catalyst in the Haber process for making ammonia.

(i) What does the term *catalyst* mean?

..... [1]

(ii) Describe a test for ammonia.

test

result [2]

- (iii)** Ammonia is used to make fertilisers.
Explain why farmers need to add fertilisers to the soil.

.....

.....

..... [2]

[Total: 12]

- 6 (a) Garlic is a vegetable that is often used in cooking. It has a strong smell. A student is cutting up garlic in the kitchen.



After a time, the smell of the garlic travels all over the house even though there are no currents of air.

Use the kinetic particle theory to explain why the smell of garlic travels all over the house.

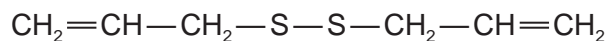
.....

.....

.....

..... [3]

- (b) The smell of garlic is due to a compound containing sulfur. The structure of this compound (compound **A**) is shown below.

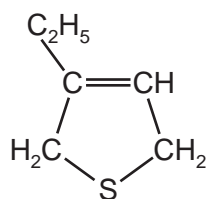


compound **A**

- (i) Write the molecular formula for this compound.

..... [1]

- (ii) Another organic sulfur compound (compound **B**) is shown below.



compound **B**

By comparing the formulae of compound **A** and compound **B**, how can you tell that compound **A** has the higher relative molecular mass?

You are not required to do any mathematical calculations.

.....

..... [2]

(c) An isotope of sulfur has a nucleon number of 34 and an atomic number of 16.

(i) How many neutrons are there in one atom of this isotope of sulfur?

..... [1]

(ii) What is meant by the terms

isotope,

..... [1]

nucleon number? [1]

(iii) Some fuels contain sulfur as a contaminating substance.
Complete the following sentences using words from the list below.

- | | | | |
|-----------------|-----------------|-----------------|-----------------|
| coal | dioxide | hydrogen | monoxide |
| nitrogen | oxidised | reduced | water |

Fuels such as contain sulfur.

When these fuels burn, the sulfur is to sulfur

This reacts with in the atmosphere to form an acidic solution. [4]

(iv) Describe and explain the effect of acid rain on buildings made of limestone.

.....

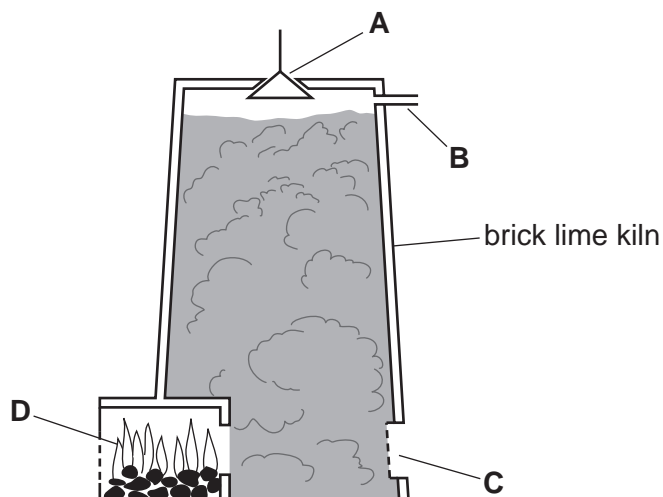
.....

..... [2]

[Total: 15]

- 7 The diagram shows a kiln for making lime (calcium oxide) from limestone (calcium carbonate).

For
Examiner's
Use



- (a) (i) Which letter on the diagram above shows
where the limestone is added,
where the waste gases exit from the kiln? [2]

- (ii) Complete the symbol equation for the decomposition of limestone.



[1]

- (iii) When 50 g of calcium carbonate is decomposed, 28 g of calcium oxide is formed.
Calculate the minimum mass of calcium carbonate needed to produce 8.4 g of calcium oxide.

[1]

- (b) The table below shows the temperatures at which some Group II carbonates decompose.

Group II carbonate	temperature at which Group II carbonates decompose / °C
beryllium carbonate	100
magnesium carbonate	350
calcium carbonate	900

- (i) Describe the pattern in the ease of decomposition of Group II carbonates.

..... [1]

(ii) Predict the decomposition temperature of barium carbonate.

..... °C [1]

(c) Lime is calcium oxide.

(i) State **one** use of lime.

..... [1]

(ii) What type of oxide is calcium oxide?

..... [1]

(iii) Calculate the relative formula mass of calcium oxide.
Use your Periodic Table to help you.

[1]

(d) Calcium is extracted from its compounds by electrolysis.
Suggest why calcium is extracted by electrolysis rather than by reduction with carbon.

..... [1]

[Total: 10]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																																																																									
I	II	III	IV	V	VI	VII	0																																																																																																																																																				
		1 H Hydrogen 1																																																																																																																																																									
7 Li Lithium 3	9 Be Beryllium 4		11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58-71 Lanthanoid series	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	†90-103 Actinoid series	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Lv Livermorium 115	116 Ts Tennessine 116	117 Og Oganesson 117	118 Uue Ununennium 118	119 Uuq Unbinilium 119	120 Uub Unbibium 120	121 Uut Untrium 121	122 Uuq Unquadrium 122	123 Uup Unpentium 123	124 Uuq Unsextium 124	125 Uur Unseptium 125	126 Uuq Unoctium 126	127 Uus Unnonium 127	128 Uuq Undecium 128	129 Uur Undecium 129	130 Uuq Untrium 130	131 Uus Unquadrium 131	132 Uur Unpentium 132	133 Uuq Unsextium 133	134 Uur Unseptium 134	135 Uus Unoctium 135	136 Uuq Unnonium 136	137 Uur Undecium 137	138 Uus Untrium 138	139 Uuq Unquadrium 139	140 Uur Unpentium 140	141 Uus Unsextium 141	142 Uur Unseptium 142	143 Uus Unoctium 143	144 Uuq Unnonium 144	145 Uur Undecium 145	146 Uus Untrium 146	147 Uuq Unquadrium 147	148 Uur Unpentium 148	149 Uus Unsextium 149	150 Uur Unseptium 150	151 Uus Unoctium 151	152 Uuq Unnonium 152	153 Uur Undecium 153	154 Uus Untrium 154	155 Uuq Unquadrium 155	156 Uur Unpentium 156	157 Uus Unsextium 157	158 Uur Unseptium 158	159 Uus Unoctium 159	160 Uuq Unnonium 160	161 Uur Undecium 161	162 Uus Untrium 162	163 Uuq Unquadrium 163	164 Uur Unpentium 164	165 Uus Unsextium 165	166 Uur Unseptium 166	167 Uus Unoctium 167	168 Uuq Unnonium 168	169 Uur Undecium 169	170 Uus Untrium 170	171 Uuq Unquadrium 171	172 Uur Unpentium 172	173 Uus Unsextium 173	174 Uur Unseptium 174	175 Uus Unoctium 175

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

a	X
b	

Key
 a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number

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